

CLAIMS

1. A *Marchantiales*-derived gene that hybridizes under stringent conditions with all of or part of a DNA nucleotide sequence, or its complementary sequence, of SEQ ID NO: 1, and encodes a protein having a  $\Delta 6$  fatty acid desaturating activity.

2. A gene that encodes a *Marchantiales*-derived protein having a  $\Delta 6$  fatty acid desaturating activity, and that (a) consists of a nucleotide sequence of SEQ ID NO: 1, or (b) hybridizes under stringent conditions with a DNA nucleotide sequence, or its complementary sequence, of SEQ ID NO: 1.

3. A gene that encodes a *Marchantiales*-derived protein having a  $\Delta 6$  fatty acid desaturating activity, and that (a) consists of a nucleotide sequence of from the 253rd to 1698th nucleotides of SEQ ID NO: 1, or (b) hybridizes under stringent conditions with a DNA nucleotide sequence of from the 253rd to 1698th nucleotides, or its complementary sequence, of SEQ ID NO: 1.

4. A gene that encodes a *Marchantiales*-derived protein having a  $\Delta 6$  fatty acid desaturating activity, and that (a) encodes a protein with an amino acid sequence of SEQ ID NO:

2, or (b) encodes a protein with an amino acid sequence that has been modified by substitution, deletion, insertion, and/or addition of one or more amino acids of SEQ ID NO: 2.

5. A *Marchantiales*-derived gene that hybridizes under stringent conditions with all of or part of a DNA nucleotide sequence, or its complementary sequence, of SEQ ID NO: 3, and encodes a protein having a  $\Delta 6$  chain elongating activity.

6. A gene that encodes a *Marchantiales*-derived protein having a  $\Delta 6$  chain elongating activity, and that (a) consists of a nucleotide sequence of SEQ ID NO: 3, or (b) hybridizes under stringent conditions with a DNA nucleotide sequence, or its complementary sequence, of SEQ ID NO: 3.

7. A gene that encodes a *Marchantiales*-derived protein having a  $\Delta 6$  chain elongating activity, and that (a) consists of a nucleotide sequence of from the 194th to 1066th nucleotides of SEQ ID NO: 1, or (b) hybridizes under stringent conditions with a DNA nucleotide sequence of from the 194th to 1066th nucleotides, or its complementary sequence, of SEQ ID NO: 1.

8. A gene that encodes a *Marchantiales*-derived protein

having a  $\Delta 6$  chain elongating activity, and that (a) encodes a protein with an amino acid sequence of SEQ ID NO: 4, or (b) encodes a protein with an amino acid sequence that has been modified by substitution, deletion, insertion, and/or addition of one or more amino acids of SEQ ID NO: 4.

9. A *Marchantiales*-derived gene that hybridizes under stringent conditions with all of or part of a DNA nucleotide sequence, or its complementary sequence, of SEQ ID NO: 5, and encodes a protein having a  $\Delta 5$  fatty acid desaturating activity.

10. A gene that encodes a *Marchantiales*-derived protein having a  $\Delta 5$  fatty acid desaturating activity, and that (a) consists of a nucleotide sequence of SEQ ID NO: 5, or (b) hybridizes under stringent conditions with a DNA nucleotide sequence, or its complementary sequence, of SEQ ID NO: 5.

11. A gene that encodes a *Marchantiales*-derived protein having a  $\Delta 5$  fatty acid desaturating activity, and that (a) consists of a nucleotide sequence of from the 375th to 1829th nucleotides of SEQ ID NO: 5, or (b) hybridizes under stringent conditions with a DNA nucleotide sequence of from the 375th to 1829th nucleotides, or its complementary sequence, of SEQ

ID NO: 5.

12. A gene that encodes a *Marchantiales*-derived protein having a  $\Delta 5$  fatty acid desaturating activity, and that (a) encodes a protein with an amino acid sequence of SEQ ID NO: 6, or (b) encodes a protein with an amino acid sequence that has been modified by substitution, deletion, insertion, and/or addition of one or more amino acids of SEQ ID NO: 6.

13. A protein encoded by a gene of any one of claims 1 through 12.

14. A protein (a) consisting of an amino acid sequence of SEQ ID NO: 2, or (b) consisting of an amino acid sequence that has been modified by substitution, deletion, insertion, and/or addition of one or more amino acids of SEQ ID NO: 2, and having a  $\Delta 6$  fatty acid desaturating activity.

15. A protein (a) consisting of an amino acid sequence of SEQ ID NO: 4, or (b) consisting of an amino acid sequence that has been modified by substitution, deletion, insertion, and/or addition of one or more amino acids of SEQ ID NO: 4, and having a  $\Delta 6$  chain elongating activity.

16. A protein (a) consisting of an amino acid sequence of SEQ ID NO: 6, or (b) consisting of an amino acid sequence that has been modified by substitution, deletion, insertion, and/or addition of one or more amino acids of SEQ ID NO: 6, and having a  $\Delta 5$  fatty acid desaturating activity.

17. An antibody which recognizes a protein of any one of claims 13 through 16.

18. A recombinant expression vector which comprises a gene of any one of claims 1 through 12.

19. A transformant into which a gene of any one of claims 1 through 12 is introduced.

20. A plant into which at least a gene of any one of claims 1 through 12 is expressibly introduced, its progeny or vegetatively propagated plants having the same characteristics, or a tissue of the plant.

21. A plant into which at least a gene of any one of claims 1 through 12 is expressibly introduced and whose fatty acid composition is thereby modified, its progeny or vegetatively propagated plants having the same

characteristics, or a tissue of the plant.

22. A reproductive material of a plant of claim 20 or 21.

23. A method of producing fatty acids, using a plant or a plant tissue of claim 21.

24. A material substance which includes at least one compound selected from the group consisting of:  $\gamma$ -linolenic acid; dihomo- $\gamma$ -linolenic acid; arachidonic acid; stearidonic acid; eicosatetraenoic acid; and eicosapentaenoic acids, which are obtained by a method of claim 23.

25. A method of modifying a fatty acid composition, using at least a gene of any one of claims 1 through 12.

26. A gene detecting instrument comprising as a probe at least a portion of a nucleotide sequence, or its complementary sequence, of a gene of any one of claims 1 through 12.

27. A screening method of a gene or substance that regulates a protein of any one of claims 13 through 16, using a protein of any one of claims 13 through 16.

28. A gene or substance obtained by a screening method of claim 27.